

What is claimed is:

1. A process comprising:
physical vapor deposition (PVD) forming a refractory metal silicide first film above a conductive plug;
forming a refractory metal silicide nitride second film above the refractory metal silicide first film; and
PVD forming a refractory metal third film above the refractory metal silicide nitride second film.
2. The process according to claim 1, wherein forming the first film, forming the second film, and forming the third film are carried out in a single tool.
3. The process according to claim 1, wherein the conductive plug includes a characteristic dimension, and wherein PVD forming a refractory metal third film is carried out under conditions to cause an average grain size therein, wherein the average grain size is larger than the conductive plug characteristic dimension.
4. The process according to claim 1, wherein the conductive plug includes a characteristic dimension W , and wherein forming the refractory metal third is carried out under conditions to cause an average grain size \bar{g} therein, and wherein $0.1W \leq \bar{g} \leq 10W$.
5. The process according to claim 1, wherein PVD forming a refractory metal silicide first film above a conductive plug, includes forming a refractory metal silicide first film that has a melting point above about 900°C .

6. The process according to claim 1, wherein PVD forming a refractory metal silicide first film includes forming a refractory metal silicide first film, wherein the silicide is MSi_x , wherein the refractory metal is M and wherein $0 < x \leq 3$.
7. The process according to claim 1, wherein forming an amorphous refractory metal silicide nitride second film includes reactive PVD forming from a refractory metal silicide target, and wherein the amorphous metal silicide nitride second film is MN_ySi_x , wherein the refractory metal is M, wherein $0 < x \leq 3$, and wherein $0 < y \leq 1$.
8. The process according to claim 1, wherein forming an amorphous refractory metal silicide nitride second film includes sputtering a refractory metal silicide target in the presence of nitrogen, wherein the refractory metal silicide target includes a composition of MSi_x , wherein M is selected from Ta, TaW, TaWTi, TaMo, TaMoTi, TaHf, TaHfTi, W, WTi, WMoTi, WHf, WHfTi, Mo, MoTi, MoHf, MoHfTi, and HfTi, and combinations thereof, and wherein $0 < x \leq 3$.
9. The process according to claim 1, wherein the process further includes:
forming a silicide structure from the refractory metal silicide first film and the conductive plug.
10. The process according to claim 1, wherein the process further includes:
rapid thermal processing the refractory metal silicide first film and the conductive plug under conditions to form a silicide structure; and
thermal processing the amorphous refractory metal silicide nitride second film under conditions to substantially resist migration of nitrogen therefrom.

11. A process comprising:

physical vapor deposition (PVD) forming a refractory metal silicide first film above a conductive plug, wherein the conductive plug includes a characteristic dimension, wherein the refractory metal silicide first film is selected from MSi_x , wherein M is selected from Ta, TaW, TaWTi, TaMo, TaMoTi, TaHf, TaHfTi, W, WTi, WMoTi, WHf, WHfTi, Mo, MoTi, MoHf, MoHfTi, and HfTi, and combinations thereof, wherein $0 < x \leq 1.8$;

in the presences of nitrogen, reactive PVD forming an amorphous refractory metal silicide nitride second film above the refractory metal silicide first film, wherein the amorphous refractory metal silicide nitride second film is selected from TaN_ySi_x , $TaWN_ySi_x$, $TaWTiN_ySi_x$, $TaMoN_ySi_x$, $TaMoTiN_ySi_x$, $TaHfN_ySi_x$, $TaHfTiN_ySi_x$, WN_ySi_x , $WTiN_ySi_x$, $WMoTiN_ySi_x$, $WHfN_ySi_x$, $WHfTiN_ySi_x$, MoN_ySi_x , $MoTiN_ySi_x$, $MoHfN_ySi_x$, $MoHfTiN_ySi_x$, and $HfTiN_ySi_x$, and combinations thereof, wherein $0 < x \leq 2.5$, and wherein $0 < y \leq 1$; and

PVD forming a refractory metal third film above the amorphous refractory metal silicide nitride second film under conditions to cause an average grain size therein, wherein the average grain size is in a range from about one-tenth the characteristic dimension to larger than the conductive plug characteristic dimension.

12. The process according to claim 11, wherein forming the first film, forming the second film, and forming the third film are carried out in a single tool.

13. The process according to claim 11, wherein the process further includes:

forming a salicide structure from the refractory metal silicide first film and the conductive plug.

14. The process according to claim 11, wherein the process further includes:

rapid thermal processing the refractory metal silicide first film and the conductive plug under conditions to form a salicide structure; and

thermal processing the amorphous refractory metal silicide nitride second film under conditions to substantially resist migration of nitrogen therefrom.

15. A process comprising:

PVD forming a refractory metal silicide first film above a conductive plug;

PVD forming an titanium nitride second film above the refractory metal silicide first film;

and

forming a refractory metal third film over the titanium nitride second film.

16. The process according to claim 15, wherein the conductive plug includes a characteristic dimension, and wherein forming the refractory metal third film is carried out under conditions to cause an average grain size therein, wherein the average grain size is larger than the conductive plug characteristic dimension.

17. The process according to claim 15, wherein the conductive plug includes a characteristic dimension and wherein forming the refractory metal third film is carried out under conditions to cause an average grain size therein, and wherein the average grain size is in a range from about one-tenth the characteristic dimension to larger than the characteristic dimension.

18. The process according to claim 15, wherein the process further includes:

forming a silicide structure from the refractory metal silicide first film and the conductive plug.

19. The process according to claim 15, wherein forming a tungsten third film over the titanium nitride second film is carried out by a chemical vapor deposition (CVD) process.

20. The process according to claim 15, wherein forming the first film, forming the second film, and forming the third film are carried out in a single tool.
21. The process according to claim 15, wherein forming the refractory metal silicide first film includes forming a solid solution refractory metal silicide first film, wherein the solid solution includes a refractory metal M according to MSi_x , and wherein $0 < x \leq 3$.
22. The process according to claim 15, wherein the process further includes:
forming a silicide structure from the refractory metal silicide first film and the conductive plug; and
forming a dielectric cap layer over the refractory metal third film.
23. The process according to claim 15, wherein the process further includes:
thermal processing the refractory metal silicide nitride second film under conditions to substantially resist migration of nitrogen therefrom; and
forming a nitride cap layer over the refractory metal third film.
24. The process according to claim 15, wherein the process further includes:
rapid thermal processing the refractory metal silicide first film and the conductive plug under conditions to form a silicide structure; and
thermal processing the refractory metal silicide nitride second film under conditions to substantially resist migration of nitrogen therefrom.
25. A buried digit line structure comprising:
a conductive plug coupled to a substrate, wherein the conductive plug includes a characteristic dimension;

a salicide first film above the conductive plug;
 a refractory metal silicide nitride second film above the salicide first film; and
 a refractory metal third film above the refractory metal silicide nitride second film, wherein the refractory metal third film includes an average grain size that is in a range from about one-tenth the conductive plug characteristic dimension to larger than the conductive plug characteristic dimension.

26. The buried digit line structure according to claim 25, wherein the conductive plug characteristic dimension is in a range from about a 0.25 micron geometry to about a 0.11 micron geometry.

27. The buried digit line structure according to claim 25, wherein salicide first film has a thickness from about 30 Å to about 300 Å, wherein the refractory metal silicide nitride second film has a thickness from about 50 Å to about 500 Å, and wherein the refractory metal third film has a thickness from about 30 Å to about 3,000 Å.

28. The buried digit line structure according to claim 25, wherein salicide first film has a thickness of about 130 Å, wherein the refractory metal silicide nitride second film has a thickness of about 100 Å, and wherein the refractory metal third film has a thickness of about 350 Å.

29. The buried digit line structure according to claim 25, wherein the salicide first film is MSi_2 , wherein M is selected from Ta, W, Mo, Hf, Ti, $TaTi_x$, WTi_x , $MoTi_x$, $HfTi_x$, TaW_x , $Ta_yW_zTi_x$, Ta_xMo , $Ta_yMo_zTi_x$, Ta_xHf , $Ta_yHf_zTi_x$, W_xTi , W_xMo , $W_yMo_zTi_x$, W_xHf , $W_yHf_zTi_x$, Mo_xHf , and $Mo_yHf_zTi_x$, wherein $0.001 \leq x \leq 0.99$, wherein $0.2 \leq y \leq 0.9$, and wherein $0.1 \leq z \leq 0.8$.

30. The buried digit line structure according to claim 29, wherein the refractory metal silicide nitride second film is selected from TaN_pSi_q , WN_pSi_q , MoN_pSi_q , HfN_pSi_q , and combinations thereof wherein $0 < q \leq 2.5$, and wherein $0 < p \leq 1$.

31. The buried digit line structure according to claim 25, wherein the salicide first film is selected from TaSi_2 , WSi_2 , MoSi_2 , HfSi_2 , and combinations thereof, wherein the refractory metal silicide nitride second film is selected from TaN_ySi_x , WN_ySi_x , MoN_ySi_x , HfN_ySi_x , and combinations thereof wherein $0 < x \leq 2.5$, and wherein $0 < y \leq 1$.

32. The buried digit line structure according to claim 25, wherein the refractory metal third film includes a resistivity in a range from about $0.1 \text{ } \Omega/\text{sq}$ to about $1,000 \text{ } \Omega/\text{sq}$.

33. A buried digit line structure comprising:

- a conductive plug coupled to a substrate, wherein the conductive plug includes a characteristic dimension;

- a salicide first film above the conductive plug;

- a titanium nitride second film above the salicide first film; and

- a refractory metal third film above the titanium nitride second film, wherein the refractory metal third film includes an average grain size that is in a range from about one-tenth the conductive plug characteristic dimension to larger than the conductive plug characteristic dimension.

34. The buried digit line structure according to claim 33, wherein the conductive plug characteristic dimension is in a range from about a 0.25 micron geometry to about a 0.11 micron geometry.

35. The buried digit line structure according to claim 33, wherein the salicide first film has a thickness from about 30 Å to about 300 Å, wherein the titanium nitride second film has a thickness from about 25 Å to about 500 Å, and wherein the refractory metal third film has a thickness from about 30 Å to about 3,000 Å.

36. The buried digit line structure according to claim 33, wherein the salicide first film has a thickness of about 130 Å, wherein the titanium nitride second film has a thickness of about 100 Å, and wherein the refractory metal third film has a thickness of about 350 Å.

37. The buried digit line structure according to claim 33, wherein the salicide first film is MSi_2 , wherein M is selected from Ta, W, Mo, Hf, Ti, $TaTi_x$, WTi_x , $MoTi_x$, $HfTi_x$, TaW_x , $Ta_yW_zTi_x$, Ta_xMo , $Ta_yMo_zTi_x$, Ta_xHf , $Ta_yHf_zTi_x$, W_xTi , W_xMo , $W_yMo_zTi_x$, W_xHf , $W_yHf_zTi_x$, Mo_xHf , and $Mo_yHf_zTi_x$, wherein $0.001 \leq x \leq 0.99$, wherein $0.2 \leq y \leq 0.9$, and wherein $0.1 \leq z \leq 0.8$.

38. The buried digit line structure according to claim 33, wherein the refractory metal third film includes a resistivity in a range from about 0.1 Ω/sq to about 1,000 Ω/sq.

39. An electrical device comprising:

- a conductive plug coupled to a substrate, wherein the conductive plug includes a characteristic dimension;

- a salicide first film above the conductive plug;

- a refractory metal compound second film above the salicide first film; and

- a refractory metal third film above the refractory metal compound second film, wherein the refractory metal third film includes an average grain size that is in a range from about one-tenth the conductive plug characteristic dimension to larger than the conductive plug characteristic dimension.

40. The electrical device according to claim 39, wherein the refractory metal compound second film is selected from titanium nitride, and a refractory metal nitride silicide.
41. The electrical device according to claim 39, wherein the refractory metal third film includes a resistivity in a range from about 0.1 Ω/sq to about 1,000 Ω/sq .
42. The electrical device according to claim 39, wherein the electrical device further includes:
a chip package, wherein the substrate is disposed in the chip package.
43. The electrical device according to claim 39, wherein the electrical device further includes:
a chip package, wherein the substrate is disposed in the chip package; and
a host, wherein the chip package is disposed in the host.
44. The electrical device according to claim 39, wherein the electrical device further includes:
a chip package, wherein the substrate is disposed in the chip package; and
a host, wherein the chip package is disposed in the host, wherein the host includes a memory module.
45. The electrical device according to claim 39, wherein the electrical device further includes:
a chip package, wherein the substrate is disposed in the chip package; and
a host, wherein the chip package is disposed in the host, wherein the host includes a memory module; and
an electronic system, wherein the memory module is disposed in the electronic system.
46. The electrical device according to claim 39, wherein the electrical device further includes:
a chip package, wherein the substrate is disposed in the chip package;

a host, wherein the chip package is disposed in the host, wherein the host includes a dynamic random access memory module; and

an electronic system, wherein the dynamic random access memory module is disposed in the electronic system.

47. The electrical device according to claim 39, wherein the electrical device further includes:
a chip package, wherein the substrate is disposed in the chip package;
a host, wherein the chip package is disposed in the host; and
an electronic system, wherein the host is disposed in the electronic system.

48. A computer system, comprising:
a processor;
a memory system coupled to the processor;
an input/output (I/O) circuit coupled to the processor and the memory system; and
a buried digit line structure disposed in the processor or the memory system, the buried digit line structure including:

a conductive plug coupled to a substrate, wherein the conductive plug includes a characteristic dimension;

a salicide first film above the conductive plug;

a refractory metal compound second film above the salicide first film; and

a refractory metal third film above the refractory metal compound second film,

wherein the refractory metal third film includes an average grain size that is in a range from about one-tenth the conductive plug characteristic dimension to larger than the conductive plug characteristic dimension.

49. The computer system according to claim 48, wherein the processor is disposed in a host selected from a clock, a television, a cell phone, a personal computer, an automobile, an industrial control system, an aircraft, and a hand-held.

50. The computer system according to claim 48, wherein the memory system is disposed in a host selected from a clock, a television, a cell phone, a personal computer, an automobile, an industrial control system, an aircraft, and a hand-held.

51. The computer system according to claim 48, wherein the refractory metal third film includes a resistivity in a range from about 0.1 Ω/sq to about 1,000 Ω/sq .